Mumbai University

Question Paper

[IDOL – Revised Course]

(April – 2015)

PAPER - II

DIGITAL

SIGNALS AND SYSTEMS

Time: 3 Hours **Total Marks:** 100

N.B.: **(1)** *All Question are Compulsory.*
(2) *Make Suitable Assumptions Wherever Necessary And State The Assumptions Made.*
(3) *Answer To The Same Question Must Be Written Together.*
(4) *Number To The Right Indicates Marks.*
(5) *Draw Neat Labeled Diagrams Wherever Necessary.*
(6) *Use of Non – Programmable Calculator is allowed.*

Q.1 ATTEMPT ANY TWO QUESTIONS: (10 MARKS)

(A) What are the applications of Digital Signal Processing? **(5)**
(B) Explain the Paley-Wiener Criterion. **(5)**
(C) Explain any five properties of DFT. **(5)**
(D) What are the advantages of Digital Filters? Explain. **(5)**

Q.2 ATTEMPT ANY THREE QUESTIONS: (15 MARKS)

(A) Define and give the graphical representation of the following functions: **(5)**
(i) *Unit ramp*
(ii) *Unit step*
(iii) *Unit impulse*
(B) State and prove Parseval's Theorem for Fourier Transform. **(5)**
(C) What is meant by Sampling? State Sampling Theorem. **(5)**
(D) Show that the product of two even signals or two odd signals is an even signal and that the product of an Even and an Odd Signal is an Odd Signal. **(5)**
(E) State and explain any five properties of Fourier Transform. **(5)**
(F) Write a note on Dirichlet's Conditions. **(5)**

Q.3 ATTEMPT ANY THREE QUESTIONS: (15 MARKS)

(A) Find the Laplace Transform of $cos^3 3t$. **(5)**
(B) State and explain any five properties of Laplace Transform. **(5)**
(C) Determine Poles, Zeros of F(s). Obtain $f(t) = 4.\frac{(s+1)(s+3)}{(s+2)(s+4)}$ **(5)**
(D) Discuss Final Value Theorem in Laplace Transform Domain. **(5)**
(E) Derive from the principles, the Laplace Transform of a unit step function. Hence or otherwise determine the Laplace transform of a unit ramp function and a unit impulse function. **(5)**
(F) Find the Laplace Transform of: **(5)**
(i) $e^{-t}\sin 4t$
(ii) $e^{2t} + 2te^{-2t} - t^2$

Q.4 ATTEMPT ANY THREE QUESTIONS: (15 MARKS)

(A) Define z-Transform. What is the use of z-transform how is it obtained from Laplace Transform? **(5)**
(B) State and explain any five properties of z-transform. **(5)**
(C) Obtain the Z-Transformation of $x(n) = 2^n u(n-2)$. **(5)**
(D) Determine the Z-Transform and rule the region of Convergence of $x(n) = \begin{cases} 2^n & n \geq 0 \\ 0 & n < 0 \end{cases}$ **(5)**
(E) State the Contour-integration Residue method to calculate Inverse Z-Transformation. Hence obtain Inverse Z-transform of $X(z) = \frac{1}{(z-1)(z+3)}$. **(5)**
(F) Determine the convolution of the two sequences $x(n) = \{2, 1, 0, 0, 5\}$ and $h(n) = \{2, 2, 1, 1\}$. **(5)**

[TURN OVER]

Q.5 ATTEMPT ANY THREE QUESTIONS: (15 MARKS)

(A) Explain stability in Linear Time Invariant System. What is the condition for a system to be BIBO Stable? **(5)**

(B) Check whether the following systems are BIBO Stable or not. **(5)**

(i) $y(n) = ax(n+1) + bx(n-1)$

(ii) $y(n) = ax(n).x(n-1)$

(C) Check whether the system $F[x(n)] = n[x(n)]^2$ is Linear and Time Variant. **(5)**

(D) Obtain Frequency Response for $y(n) = x(n) + 10y(n-1)$ with initial condition $y(-1) = 0$. **(5)**

(E) Find the convolution of the two signals $x(n) = u(n)$ and $h(n) = a^n u(n), ROC: |a| < 1; n \geq 0$ **(5)**

(F) What is the Frequency Response? What are the properties of Frequency Response? **(5)**

Q.6 ATTEMPT ANY THREE QUESTIONS: (15 MARKS)

(A) Define Discrete Fourier Transform (DFT) and Inverse Discrete Fourier Transform (IDFT). Also state the Complex Conjugate Property and Circular Convolution Property of Discrete Fourier Transform (DFT). **(5)**

(B) Obtain $X(k)$ for the sequence $x(n) = \{1,2,3,4,4,3,2,1\}$ using Decimation-in-Time (DIT), Fast Fourier Transform (FFT) Algorithm. **(5)**

(C) What are the methods used to perform Fast Convolution. Explain any one method giving all the steps involved to perform Fast Convolution. **(5)**

(D) Compute Linear and Circular Periodic Convolutions of the sequence $x_1(n) = \{1,1,2,2\}$ and $x_2(n) = \{1,2,3,4\}$ using DFT. **(5)**

(E) Determine DFT of the Sequence $x(n) = \begin{cases} 1 & 0 \leq n \leq 2 \\ 4 & \\ 0 & otherwise \end{cases}$ **(5)**

(F) Compute the N-point Discrete Fourier Transform of $x(n) = a^n$ for $0 < a < 1$ **(5)**

Q.7 ATTEMPT ANY THREE QUESTIONS: (15 MARKS)

(A) What is Bilinear Transformation? Apply Bilinear Transformation to $H(s) = \frac{2}{(S+1)(S+3)}$ with $T = 0.1\ S$. **(5)**

(B) Describe the Inverse Chebyshev filters. **(5)**

(C) Obtain the system functions of normalized Butterworth filters for order $N = 1$ and $N = 2$. **(5)**

(D) What is an IIR Filter? Compare its characteristics with an FIR Filter. **(5)**

(E) Write note on Chebyshev Filters. **(5)**

(F) Explain the effects of windowing. Define Rectangular and Hamming Window Functions. **(5)**